George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

Materials and Processes Laboratory, EM01

Metals Engineering Branch, EM30

EM30-WI-004
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ORGANIZATIONAL WORK INSTRUCTION

EM30

STRESS CORROSION TEST PROCEDURE

RELEASE AUTHORITY	NAME	TITLE	ORG	DATE
Management Representative	_____ Timothy P. Vaughn	Branch Chief	EM30	02/11/2005

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1.1.1 THE MASTER VERSION OF THIS DOCUMENT IS LOCATED AT
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DOCUMENT HISTORY LOG

Revision	Date	Originator	Description
Baseline	02-11-2005	T. Vaughn	Document rebaselined due to reorganization of Departments and Laboratories at the Center

1 SCOPE

1.1 ***SCOPE:*** This document provides stress corrosion testing procedures and requirements for the Materials and Processes Laboratory, Metals Engineering Branch, Metallics Engineering Team within the scope defined by MPD 1280.1.

1.2 ***PURPOSE:*** To describe the stress corrosion testing procedures used by the Metals Engineering Branch, Metallics Engineering Team.

1.3 ***APPLICABILITY:*** This organizational work instruction applies to the Materials and Processes Laboratory, Metals Engineering Branch, Metallics Engineering Team.

2 APPLICABLE DOCUMENTS

2.1	MPD 1280.1	Marshall Management Manual
2.2	EM30-WI-002	EM30 Work Tracking, Product Traceability and Control, and Data Control
2.3	MSFC-STD-3029	Guidelines for the Selection of Metallic Materials for Stress Corrosion Cracking Resistance in Sodium Chloride Environments, May 22, 2000
2.4	ASTM B117	Standard Practice For Operating Salt Spray (Fog) Apparatus
2.5	ASTM D1193	Standard Specification for Reagent Water
2.6	ASTM G30	Standard Practice for Making and Using U-Bend Stress Corrosion Test Specimens
2.7	ASTM G38	Standard Practice for Making and Using C-Ring Stress Corrosion Test Specimens
2.8	ASTM G39	Standard Practice for Preparation and Use of Bent-Beam Stress Corrosion Test Specimens
2.9	ASTM G44	Standard Practice For Exposure of Metals and Alloys by Alternate Immersion in Neutral 3.5% Sodium Chloride Solution, 1999
2.10	ASTM G47	Standard Test Method For Determining Susceptibility to Stress Corrosion Cracking of 2XXX and 7XXX Aluminum Alloy Products
2.11	ASTM G49	Standard Practice For Preparation and Use of Direct Tension Stress Corrosion Test Specimens

2.12 ASTM G58 Standard Practice for Preparation of Stress Corrosion Test Specimens for Weldments

2.13 ASTM G64 Standard Classification of the Resistance to Stress Corrosion Cracking of Heat-Treatable Aluminum Alloys

2.14 ASTM Special Technical Publication Number 425, "Symposium on Stress Corrosion Testing", 1967.

2.15 NASA TMX-53483 Procedures for Externally Loading and Corrosion Testing Stress Corrosion Specimens, T. S. Humphries, June 29, 1966.

2.16 EH24 Memo (92-24) MSFC Stress Corrosion Test Procedure Currently Followed for Testing Round Tensile Specimens, October 22, 1992.

2.17 Visit http://standards.nasa.gov/ to view the latest versions of MSFC and ASTM standards.

3 DEFINITIONS

3.1 ***STRESS CORROSION:*** The combined action of sustained tensile stress and corrosion to cause premature failure of materials.

4 INSTRUCTIONS

4.1 ***GENERAL:*** Work performed and data generated for stress corrosion testing shall be documented and controlled.

4.2 ***REQUESTS FOR WORK:*** The EM30 Electronic Work Request Form, found on the Organizational World Wide Web site, http://128.158.136.149/PublicMMTF/WorkRequest.aspx/, must be completed prior to the start of stress corrosion testing.

4.2.1 The work request form shall be filled out by the requester and/or by Organizational personnel.

4.2.2 The request for work must be approved by Branch/Team level management or their designee and assigned to appropriate personnel before work initiation.

4.3 ***WORK ACCOMPLISHMENT:*** Stress corrosion testing shall be accomplished by various Branch personnel based on Customer requirements.

4.3.1 The material to be tested must be processed and heat treated to the desired temper.

4.3.2 The stress corrosion specimens are fabricated per corresponding drawings based on the Customer geometry requirements.

4.3.3 Unique identification numbers are assigned to each specimen, which are maintained throughout the test.

4.3.4 The specimens are stressed to the desired stress levels, cleaned, and exposed to the corresponding test environment for the desired length of exposure, or until failure.

4.3.5 When a failure occurs, the date and the number of days to failure are recorded in a log book. In addition, the log book contains the following information: date the test started, date the test ended, identification numbers, applied stress (and corresponding strain), stress direction, and the dates of failures.

4.4 ***COMPILING TEST RESULTS:*** The compilation of results usually includes, but is not limited to, the following information:

4.4.1 Description of the test material.

4.4.2 Test environment.

4.4.3 Type of specimen.

4.4.4 Applied stress and stress direction.

4.4.5 Failure ratio (number of failures over number of specimens tested at the same conditions).

4.4.6 The number of days to failure, and the test duration.

4.4.7 Additional complementary information (e.g., tables, illustrations, etc.) can be added as desired.

4.5 ***DATA REVIEW, APPROVAL, AND REPORTING:*** Reports, memos, and data shall be reviewed, approved, and reported to the customer in accordance with standard Organizational practices described in EM30-WI-002.

4.6 ***QUALITY RECORD ARCHIVING:*** All quality records produced in fulfillment of customer requirements described in the work request shall be stored in accordance with standard Organizational practices found in EM30-WI-002.

4.7 ***SAMPLE DISPOSITION:*** All samples and/or non-consumable Customer supplied materials shall be returned to the Customer or stored in accordance with standard Organizational practices described in EM30-WI-002.

4.8 ***WORK REQUEST CLOSE OUT:*** Once all applicable work has been completed, data distributed, and quality records archived, the work request shall be closed out in accordance with standard Organizational practices described in EM30-WI-002.

5 NOTES

5.1 None.

6 SAFETY PRECAUTIONS AND WARNING NOTES

6.1 The frames used for stress corrosion testing need to be coated with a plastic compound, which is melted at approximately 177 ^{o}C (350 ^{o}F). This operation is performed under a hood. During this procedure cloth or leather gloves should be used to avoid burns.

7 APPENDICES, DATA, REPORTS, AND FORMS

7.1 Not Applicable

8 QUALITY RECORDS

8.1 The following listing includes EM30 Quality Records that are collected and saved during stress corrosion testing.

8.1.1 EM30 Electronic Work Request Form.

8.1.2 EM30 Branch Memoranda.

8.1.3 Corrosion Testing Logbook.

8.2 All schedules pertaining to EM30 Quality Record retention and disposition are compiled in the EM30 Quality Records Listing located on the master list of the EM30 Branch website (http:/maptis.nasa.gov/em30/em30masterlist.html/). .

9 TOOLS, EQUIPMENT, AND MATERIALS

9.1 ***TEST SPECIMENS:*** Round tensile specimens in accordance with ASTM G49 are the most commonly used at MSFC for stress corrosion evaluations. This type of specimen has a 0.318 cm (0.125 inches) gage length diameter, 1/4-20 threads, and is 5.08 cm (2.00 inches) long. Other round tensile specimen configurations with different dimensions exist, which are used for special purposes or when the dimensions of the material do not allow the fabrication of the regular round tensile specimen. Other types of specimens include c-rings, if round tensile specimens can not be obtained, bent beams for welds, and flat tensile specimens for sheet material. The Metals Engineering Branch should be contacted to obtain the specimen drawing.

9.2 ***MATERIALS:*** Most of the stress corrosion tests at MSFC are performed on steel and aluminum alloys.

9.3 EQUIPMENT:

9.3.1 Alternate Immersion Tester: Used to evaluate materials per ASTM G44. It consists of a Ferris wheel type mechanism containing six trays, in which the specimens are distributed. This mechanism rotates 60 degrees every 10 minutes, allowing the specimens to stay in a stationary 3.5 percent NaCl solution for 10 minutes and out of the solution for 50 minutes. This cycle is repeated for the entire duration of the test.

9.3.2 Salt Spray Cabinet: Used to test specimens per ASTM B117. The apparatus consists of a chamber (cabinet made of steel with the inner shell lined with vulcanized rubber), an air saturator tower, a salt solution reservoir, an atomizing nozzle, specimen supports, a provision for heating the chamber, and controls to maintain the desired temperature. During the salt spray test, heated and humidified air from the saturator tower is passed through the nozzle, and in the process draws up a salt solution (5-percent NaCl). The salt spray operates continuously, except for the interruptions necessary to inspect the specimens.

9.3.3 High Humidity Cabinet: The high humidity cabinet is very similar in construction to the salt spray apparatus. In this test, compressed air is bubbled up through deionized water inside a steel chamber, obtaining a relative humidity between 95 and 100-percent at a temperature ranging from 35 to 39 ^{o}C (95 to 102 ^{o}F).

10 PERSONNEL TRAINING AND CERTIFICATION

10.1 The operators of corrosion testing instruments utilized by EM30 shall receive operations training from one or both of the following sources.

10.1.1 Previous primary instrument operator.

10.1.2 Instrument manufacturers training representative.

10.2 Instrument operations will not be allowed until basic safety, maintenance, and operational readiness is achieved by the operator.

11 Flow Diagram